REMARKS

This is in response to the FINAL Official Action currently outstanding with regard to the present application.

Claims 26-43 were pending in this application at the time of the issuance of the currently outstanding Official Action. Applicants propose the amendment of Claims 26, 32 and 35 as indicated above. Applicants do not propose the cancellation of any claims. Claim 36 previously has been withdrawn. Accordingly, in the event that the Examiner grants the entry of the foregoing amendment, Claims 26-35 and 37-43 will constitute the Claims under active prosecution in this application.

More particularly, in the currently outstanding Official Action the Examiner has:

1. Acknowledged Applicants' claim for foreign priority under 35 USC §119 (a)-(d) or (f), and has confirmed the receipt of the required copies of the priority documents by the United States Patent and Trademark Office;

2. Provided to the Applicants an indication that the drawings filed on 7 July 2004 have been accepted;

3. Rejected Claims 26-28, 30-32, 37-38, 40-41, and 43 under 35 USC §103(a) as being unpatentable over the Welch et al. (hereinafter "Welch") (US Patent No. 5,903,373) in view of Ota et al. (hereinafter "Ota") (US Patent No. 5,986,790);

4. Rejected Claims 33, 34 and 35 under 35 USC §103(a) as being unpatentable over the Welch (US Patent No. 5,903,373) in view of Ota (US Patent No. 5,986,790) as applied against Claim 32, and in further view of Knapp (US Patent No. 4,975,926); and Sumi et al (hereinafter "Sumi") (US Patent No. 4,536,057);

5. Indicated that Claim 29 and its dependent claims (39 and 42) are objected to as being dependent upon a rejected base claim, but that those claims would be allowable if rewritten in independent form including all of the limitations of their respective base claims and any intervening claims.

No further comment regarding items 1, 2 and 5 above is deemed to be required in these Remarks.

By the foregoing Amendment, Applicant proposes to correct a typographical error in Claim 35, and to amend Claims 26 and 32 slightly for the purposes of clarity by the insertion of wording that makes explicit limitations that were heretofore believed by Applicant to be inherent in those claims. Applicant respectfully submits that since the proposed amendment of Claim 35 is merely clerical in nature, and the proposed amendment to Claims 26 and 32 merely makes explicit limitations that were previously inherent in the claims involved, none of the proposed amendments set forth above will introduce any "new matter" or any subject matter into this application requiring further consideration and/or search by the Examiner. Hence, Applicant respectfully requests that the Examiner grant entry of the foregoing amendments in response to this communication, and that this application as so amended be allowed in view of those amendments and the Examiner's consideration of the following Remarks.

In particular, as mentioned in the Remarks that accompanied the previous Amendment in this application, Applicant respectfully submits that the Examiner has not fully understood the distinctions between space-division multiplexing as disclosed and claimed in this application, as distinguished from space division combined with multiplexing in time domains as disclosed in the art relied upon in support of the currently outstanding rejections of the claims of this application. Specifically, in the currently outstanding FINAL Official Action, the Examiner continues to assert (over Applicant's strong disagreement) that the Welch reference obviously discloses a base station for use in a space-division multiplex optical wireless network (i.e., communication channels multiplexed in terms of space) because Welch discloses multi-frequency channels and a receiver that is an angularly diverse detector. Applicant, on the other hand, respectfully submits that the Examiner's conclusion that Welsh "obviously discloses the limitations "communication channels multiplexed in terms of space" does not logically follow from the Welsh disclosure of multi-frequency channels and angularly diverse detectors. Accordingly, Applicant continues to respectfully submit that while the Welch reference may disclose space division, it does not disclose communication channels multiplexed in terms of space. As will become more apparent below, it is Applicant's position that this distinction between the Welch reference and the present invention is not simply one of semantics. Rather, it is a substantive distinction that differentiates the present invention from the art relied upon by the Examiner.

The foregoing Amendment clarifies this point by the addition of an explicit recitation of the previously inherently included fact that the angle diversity receiver as herein claimed includes a plurality of receiving elements wherein at least one of the plurality of receiving elements is separately associated with each respective one of a plurality of different space cells. Applicant respectfully submits that the art relied upon by the Examiner in support of his currently outstanding rejections simply does not teach, disclose or suggest such an angle diversity receiver.

Thus, as will also appear more fully below, even if one converts the multiplexing in time domains discussed in detail by the Welch reference into a "true" multiplexing of those time domain signals, diversity by space division remains different from space-division multiplexing. In other words, Welch contemplates a single cell and whether that cell is represented at the base station as a time sequence of signals differing only in SNR or signals multiplexed in parallel that differ only in SNR, the result remains the same, namely, Welch is processing signals based on diversity by space division of a single cell, while the present invention is processing signals based upon space-division multiplexing on the basis of a plurality of cells. Similarly, the Examiner's other comments in the currently outstanding Official Action responding to Applicant's presentation are respectfully submitted to either reach conclusions that do not necessarily follow from the prior art disclosures relied upon in support thereof, or to take isolated portions of the Applicant's discussion out of the context in which they were presented thereby distorting the arguments made by the Applicant. In view of these observations, Applicant believes that the following restatement of its previous positions is appropriate in this Amendment/Request for Reconsideration.

It is generally understood by those of ordinary skill in the art that the term "multiplexing" means that a plurality of terminals can perform communication at the same time by using a plurality of channels. It is to be understood in this regard, however, that multiplexing by space-division (the present invention) and multiplexing in time domains (Welch) are significantly different from one another. Therefore, it will be seen that in the Welch reference the structure (for example, an arrangement of detectors in the case of a receiver) provides only a spatial communication channel irrespective of whether space-division is performed or not.

Accordingly, in the Welch reference, the multiplexing of a channel for handling a plurality of terminals is performed in a time series. The features disclosed in Welch that indicate that polling of a channel is performed, and an uplink and a downlink are arranged in a time series within a single frame as shown in Fig. 3 so as to be shared among a plurality of remote terminals as shown in Fig. 6 support this interpretation. Consequently, Welch teaches, discloses and/or suggests that the number of remote terminals that can exchange information with a base station at a certain time without error is always at the maximum one.

It follows, therefore, that since multiplexing is performed in a time domain in Welch, the communication protocol disclosed thereby is limited to that set forth above. On the other hand, however, in the case of a plurality of space-division multiplexed channels such as in the present invention, each of the space channels is substantially the same as a one-to-one communication channel with a base station for a remote terminal. Accordingly, in the present invention unlike Welch, full use of a communication band of the remote terminal can be made. Similarly, the present invention provides the advantage that a number that equals the number of channels can perform communications in parallel at the same time. This inherent feature of the present invention as previously claimed is now made explicit by the foregoing proposed Amendment.

The Examiner's currently outstanding rejection again asserts his belief that (1) the remote terminal of Welch comprises a receiver of an angle diversity type (Fig. 11) and a multi-beam transmitter for outputting a plurality of beams (Fig. 10), (2) the Welch base station comprises a multi-beam transmitter for outputting a plurality of beams (Fig. 14), and (3) the Welch multi-beam transmitter includes a plurality of transmitters that each include at least one LD or LED as a light source. (Note: Figs. 10 and 11 of Welch show a remote terminal, not a base station. These showings, however, are regarded as the same herein for explanation purposes because such a remote terminal can be applied to the base station in the context of the present invention.) However, space-division as disclosed by Welch only includes angle diversity for the purpose of improving the SNR of a particular channel. Hence, on the receiver side in Welch the parallel reception signals outputted from a plurality of detectors 109 or 135 as shown in Figs. 11 or 14 are the transmission signals transmitted from a single transmission terminal according to a communication protocol calculated to avoid collisions between (among) a plurality of transmission data. Thus, the received signals in Welch are different only with respect to their SNR or an influence of multi-path reflection. Further, in Welch, one of the plurality of reception signals is selected or the signals are combined such that there is only one spatial communication channel disclosed.

In the present invention, on the other hand, each remote terminal substantially performs one-to-one communication with a base station. Consequently, it is not necessary to utilize the Welch communication protocol in order to achieve multiple connections. In addition, the disadvantage that the communication band of the remote terminal is not fully utilized does not occur in the present invention as it does in Welch. Instead, the present invention utilizes the concept of a space cell for multiplexing. Unlike Welch, this results in a dead zone boundary region between the space cells becoming important technical problem the solution of which is tied to the structure of the base station. In other words, in Welch, the whole of space is logically a single space cell whether space-division is performed or not. Therefore, in Welch, a single space cell is shared by a plurality of remote terminals in accordance with a communication protocol. In Welch, there is no concept or recognition of a space cell as an individual channel that is spatially multiplexed. Consequently, Welch does not contemplate a system including boundaries between spatially divided regions resulting in dead zones that must be accounted for in the structure and operation of the system.

Indeed, in the Welch reference as clearly shown in Figs. 10 and 11, space-divisions for transmission and reception do not have to correspond to each other at all. Instead, it is sufficient if a wide angle region is covered as a whole. In this regard, Applicant recognizes that in the base station of Welch shown in Fig. 14, space is divided in three directions in order to divide transmission/reception. It is to be understood, however, that in this case, as shown in Welch Fig. 21 (and at "AVERAGING DIVIDE BY THREE" in the circuit diagram of Welch Fig. 15) the three signals are each composed of the same transmission data as that which otherwise would be received from only one terminal. The three signals are sent out using the transmission protocol discussed above that is used to avoid transmission data collisions such that they differ only in terms of SNR or an influence of multi-path reflection. Again, since in Welch the plurality of reception signals are combined and only one space cell of the whole of space exists, the latter mode of operation is respectfully submitted to be no different in terms of the form of communication than one space cell that is shared by a plurality of remote terminals by a protocol. Hence, it will be recognized (as now made more explicit by the presently proposed amendment) that in systems utilizing multi-beam transmitters and an angle diversity type receivers, there are distinctive differences in structure and channel operation between systems using diversity by space division and systems using space-division multiplexing.

The Examiner also asserts that Ota discloses a concept of a space cell in Figs. 22 and 23 such that the present invention would have been obvious over the combination of Welch and Ota. (These figures, similarly to Figs. 10 and 11 of Welch, illustrate a transmitter/receiver of the remote terminal. They are regarded as the same herein for explanation purposes since such a remote terminal can be applied to the base station of the present application.)

In Ota, as shown in Fig. 22B and Col. 16, lines 9-12, one of seven cells is selected by manipulating the lens 175 during either transmission or reception. This means that only one spatial channel is formed, and indicates that it is impossible to cause them to operate independently. Consequently, as described by Ota at Col. 16, line 62 to Col. 17, line 11, with respect to the vertical direction, that reference tries to reduce the transmission power of remote terminals by using spatial diversity rather than by the provision of space-division multiplexing. In addition, at Col. 17, lines 11-13 with respect to a horizontal direction, Ota makes it evident that the remote terminal itself determines the timing of the handover between spatial cells provided by different base stations 121a and 121b by the use of spatial diversity. This is another indication that Ota does not assume the multiplexing of channels by space division in a single communication area.

Accordingly, Applicant respectfully submits that with regard to the difference between space division and space-division multiplexing, Welch and Ota are in the same category. Hence, even though the system of Welch is improved in comparison to the system of Ota, the same space-division multiplexing system as that of the present invention cannot be achieved by either of them. Neither the system of Ota, nor the system of Welch, provides for space-division multiplexing at least on the following two points:

First, as shown by Fig. 23 of Ota, in the Ota reference there are a plurality of transmission/receiving elements into the number of which the communication area is spatially divided. Thus, as described at Col. 15, lines 64-66, only one transmitting element 173 or receiving element 174 corresponds to one of the space cells, and it has a single light emitting element such as an LED or an LD or a single PIN-PD. In other words, the concept of assigning one or more light emitting elements or light receiving elements for grouping is not disclosed.

On the other hand, however, it is a feature of the base station of the present invention that there are at least one or more elements for each of the space cells. The Examiner appears to suggest that the Applicant improperly attempted to read this feature into the claims from the specification in the previous Amendment in this application, while Applicant respectfully submits that this feature has been inherent in the claims (and therefore not improperly read into the claims) via the use of the term "angle-diversity receiver" in conjunction with the use of the terms "space-division multiplexing" and "so as to form a plurality of space cells" when read in light of the specification throughout this prosecution – in either event, Applicant respectfully submits that entry of the foregoing Amendment will place this feature explicitly in the claims in a manner that will not require further consideration and/or search by the Examiner in view of his prior consideration of these issues.

Specifically, for example, using the Ota reference as a basic context, it will be understood that the present invention differs from the Ota reference in that in the present invention there would be one or more of the transmitting elements 173 and of the receiving elements 174 for each of the space cells 112a-g as depicted in Fig, 24. In other words, in the present invention he total number of groups of transmitting/receiving elements is the number of space cells that can be independently operated in parallel contrary to the teachings, disclosures and/or suggestions of the Ota reference. Consequently, it again will be understood that the above-described differences are based on whether the system is provided for space-division multiplexing or not, and that those differences lead to decisive distinctions regarding the structure and operational capabilities thereof for space resolution.

Accordingly, it will be seen from Fig. 23 of Ota that as was the case in the Welch reference, there is an excessive dead zone between the elements 173 and 174 disclosed in the Ota reference. This dead zone, which is located in space between the space cells formed by the respective elements disclosed by Ota, cannot be used for communication. Furthermore, a serious problem tends to occur when the space cells actually formed in space overlap excessively. In that case, when space multiplexing is performed (adjacent cells are operated in parallel) co-channel interference (CCI) inevitably occurs. Neither the Welch, nor the Ota, reference addresses this problem. It appears that the reason for this is that in the Welch and Ota systems, either a single space cell is selected or a plurality of signals that are the same are transmitted and thereafter combined into one. Accordingly, the Ota or Welch references may accurately be construed as disclosing, teaching or suggesting a transmitter or a receiver combination wherein only a diversity gain by space-division is contemplated or accomplished.

On the other hand, as has been emphasized previously, a major problem addressed by the present. invention is the sufficient suppression of co-channel interference specific to the space-division multiplexing system. This phenomenon is not a problem in systems such as those disclosed by Welsh or Ota that only perform spatial diversity. In addition, other problems addressed by the present invention include the maintenance of a high throughput without burdening the remote terminals, and the implementation of the whole system at low cost. Therefore, it will be seen that in the present invention, multiplexing of channels by space-division is a prerequisite to the successful accomplishment of its objectives. The logical consequence of this is that the problems solved by the present invention in comparison with those solved by the Ota and Welch references are quite different from one another, itself an indication of the failure of those references whether taken alone or in combination with one another to adversely impact upon the patentabiltity of the present claims.

One such problem is represented by the term "predetermined size" used with the term "space-division multiplexing" as in Claim 26 of the present application. The Examiner suggests that Ota discloses the concept of a space cell in Figure 22B and that the control of the size of that space cell is merely a matter of design choice achieved by such expedients as increasing the number of transmitters and enhancing transmission light power.

However, Applicant respectfully submits that it should be recognized that it may be necessary to individually control the directions of axes of the respective space cells (i.e., the angles of optical axes of the respective transmitting/receiving elements) only if it is assumed that a plurality of the space cells operate in parallel. This is important in light of the fact that unlike the cited art, a basic objective of space-division multiplexing is to accommodate only one remote terminal (or one user) in one space cell, thereby making the uniformity of the size of the respective cells produced by the base stations across the entire area covered by the base stations important. In addition, in order to meet this inevitable system requirement for space-division multiplexing systems, the control of the axial directions of the space cells is an essential feature. This is to be contrasted with systems such as Welch or Ota in which only spatial diversity is the objective, and it is not necessary to finely control the angles of the axes of the transmitting/receiving elements. Accordingly, in the prior art systems, it is sufficient if the system is designed to perform space-division (in the most simple case, equal division) in an angle region and to simply maximize the transmission power to individually divided space cells. Significantly, it is respectfully noted that neither Welch nor Ota describe the diameter of their space cell because that diameter does not have to be defined in the systems disclosed by them.

Regarding Claims 27 and 28, the Examiner argues that by combining Welch and Ota it would have been obvious to set different directions and angles of divergence between each transmitter of the multi-beam transmitter. While this comment may have some merit as a totally abstract proposition, Applicant respectfully submits that the technical background of the present application is so different from that of the Welch and Ota references even with respect to the necessity and manner of controlling directions to which the spatial cells are oriented are so different as to contra-indicate the combination of references suggested by the Examiner. Thus, it will be recognized in the latter regard that in order to implement a practically useful space-division multiplex system, first, the size of the actually formed space cell should be defined by setting the axis direction of the space cells that is assumed as the scene of use. Then, the directionality of each of the beams of the multi-beam transmitters should be controlled with respect to the space cells to sufficiently suppress the co-channel interference (CCI) of space-division multiplexed downlink channels. On the other hand, in a system in which only spatial diversity is an objective, it is not required to take into consideration the generation of dead zone due to co-channel interference by receiving a plurality of different signals near the boundary regions between the divided cells. Therefore, it is sufficient if the system is designed to perform simple space division in the angular region and to simply maximize the transmission light power to the individually divided space cells.

In light of the foregoing Amendment and Remarks, it will be understood that in a communication system of a space-division multiplexing type, in order to solve the specific problems that arise when the channel is space-division multiplexed, axes of the representative space cells (i.e., optical axes of the transmission space cells formed by the beams of the multi-bream transmitter and optical axes of the receiving space cells formed by the angular diversity type receivers (naturally, these should match as pairs in the respective space cells), have to be defined so as to conform to a predetermined space cell arrangement. In addition, in order to suppress co-channel interference of downlinks (communication from a base station to a remote terminal), the degree of directionality (i.e., half value angle) should be controlled. The optimum value of this variable depends upon the setting of the axial directions of the respective space cells. This is not described in either Welch or Ota, but is discussed in the present specification.

With respect to Claims 30, 37, and 38, the Examiner indicates that Fig. 22B of Ota discloses a structure in which a base station receiver including a lens dedicated for reception is composed of a plurality of segments that are capable of outputting signals individually. The relationship referred to by the Examiner can be readily understood by comparing a pair of (a) and (c) and a pair of (b) and (d) in Fig. 8 of the present application. Thus, assume that both structures (a) and (b) of Fig. 8 perform three space-division multiplexing operations in a certain angle direction, similar to that shown in (c) of Fig. 8. In such a case, in the structure of the angle-diversity type receiver of (b) of Fig. 8, there are three detector outputs for each angle range divided into three, i.e., nine detector outputs in total. Thus, the spatial resolution of each of the detectors is three times that of the divided space cells. By selecting the one having a maximum SNR out of the three detector outputs corresponding to one space cell, or combining the outputs to generate one output, an output that is independently operable can be obtained for each of the three space cells.

On the other hand, in the structure of the angle diversity type receiver shown at (a) of Fig. 8 of the present application, there is one detector output for each of the three divided angle ranges, and the scope of the resolutions of the respective detectors are equal to those of the divided space cells (of course, if the total number of the space channels is small, even this structure can be used as a space-division multiplexing system by retrieving three independent outputs for three space cells). At the same time, the structure corresponds to that shown on the right hand side of Fig. 22 of Ota. However, in the case of Ota, it is to be recognized that space diversity is performed by selecting one having the maximum SNR out of three outputs obtained for the entire space, or combining them to generate only one output. The structure shown in Fig. 14 of Welch corresponds to the latter structure. As described at Col. 13, lines 53-55 of Welch, a single output can be obtained from a set of a plurality of detectors having the same optical axis that are arranged in parallel as an array. However, as described at Col. 8, lines 31-38 of Welch, this expedient merely forms a single omnidirectional space channel as a transmitter/receiver the same as disclosed by Ota.

Accordingly, Applicant respectfully submits that the differences between the diversity by simple space division and multiplexing of channels by space-division are significant. Further, Applicant respectfully submits that it is clear that the angle diversity type receiver of the base station of the present invention should have a resolution higher than those of the predetermined space cells in order to adequately receive an uplink signal which is output from a remote terminal near the boundary between the adjacent space cells as an accurately separated space-division multiplexed channel in the base station receiver.

With respect to Claims 31, 40, 41 and 43, the Examiner argues that Welch and Ota do not clearly show that the radius of a space cell is from 20 to 100 cm, but since this is merely a matter of design choice and can be attributed to a number of known devices, it would have been obvious to those skilled in the art.

In this regard, the difference between spatial diversity by space division and multiplexing of channels by space division plays an important role. As described above, in the case of simple spatial diversity, space-division usually is performed in an angle region. For example, as described in Col. 13, lines 13-24 of Welch, arrays consisting of four detectors are mounted with 0 degree, +45 degree and –45 degree slants so as to perform three space divisions. This manner of space division does not depend on the minimum or the maximum communication distance assumed by the system and should always be mounted at 0 degree, at +45 degree and at –45 degree. Further, in this manner of space division of an angle region, the size of the space cell usually is considerably larger than that of the space cell assumed in the present application. Hence, the cost benefit that is achieved by the present application cannot be obtained when the system just mentioned is applied to the space-division multiplexing system.

On the other hand, in the space-division multiplexing of the present invention, it is desirable to define the size of the space cell in terms of a distance, i.e., as a radius equal to the distance between a base station and a terminal between which communication is to be frequently performed, not an angle region. Thus, a desirable form of the space-division multiplexing system of the present invention accommodates only one remote terminal (or one user) in one space cell so as to obtain maximum throughput without burdening the remote terminals with a complicated protocol processing function. In other words, it is desirable in the present invention that the size of the respective space cells generated by a base station is within an appropriate range in which an individual user carrying the remote terminal may exist. In a setting such as a small office wherein a range of the maximum communication distance (distance between a base station and a terminal) of about 1 to 5 m is assumed for accommodating a normal IrDa mounted terminal, the optimum space cell radius generally should be limited to 20 to 100 cm. This is an important feature that is specifically recognized in the above-described problem to be solved of the present invention, i.e., space-division multiplexing for incorporating an optical wireless network while alleviating the burden on a remote terminal and maintaining a high throughput is maintained with low cost.

Further, with respect to cell size, important teachings concerning the structure of an optical wireless system of a space-division multiplexing type are found in the prior art documents cited in the specification of the present application. Specifically, in prior optical wireless systems performing space-division multiplexing, for both transmitters and receivers of angle diversity type in the base station, monolithic semiconductor arrays were used as light source elements and light receiving elements.

In addition, imaging by a lens system was performed to significantly increase the space resolution of the respective transmitting and receiving elements. This was particularly the case when a multi-beam transmitter was formed in a base station transmission system using monolithic semiconductor elements in which planar light emitting lasers or LEDs were arranged in arrays, and a lens system common to all the light emitting elements was provided such that the angles formed by respective light emitting elements were in a very narrow and acute pattern. For covering an area of a significant breadth, the number of the array elements sharply increases and the size of a die became extremely large. In this situation, since the die is an expensive compound semiconductor, it directly led to undesirable increases in the cost of the base station.

In order to implement a space-division multiplexing system at reasonable cost, therefore, it is essential that, in the base station transmission system, a multi-beam transmitter is formed of discrete light emitting elements (see Fig. 1, 102 of the present application). Also, it is essential that monolithic photodiode arrays are provided on a focal plane of the lens system in the base station receiving system to implement a high space resolution (see Fig. 1, 102 of the present application). These requirements to Applicant's knowledge are disclosed for the first time by the present application.

With respect to the features of the remote terminal to be incorporated into the space-division multiplexing system of the present application (Claims 33, 34 and 35), the Examiner has alleged that Claims 33, 34 and 35 would have been obvious over Knapp and Sumi in view of Welch and Ota. More particularly, regarding Claim 33, the Examiner admits that Welch and Ota do not disclose a structure including an optical filter which can be easily attached and detached and which can attenuate a specific light transmitted by the terminal. However, the Examiner asserts that Knap discloses a structure in which an optical filter for attenuating a background light other than a signal light is incorporated into a lens system of a base station receiver while conceding that means for attaching and detaching the optical filter is not described in that reference. To supply the missing element, the Examiner relies on the Sumi reference that he asserts discloses means for attaching and detaching the optical filter (in a camera lens assembly).

In the latter regards it is to be noted that, in the present application: 1) one of the disclosed objects is to include an optical filter in a remote terminal; and 2) the light which should be selectively attenuated by the optical filter is transmission signal light of the terminal itself, not the background light or light of a signal transmitted from other terminals or base stations. This means that to remove background light or other noise light by the filter in a receiver of a remote terminal to improve SNR of a signal is totally different from the objective of Claim 33 of the present application. The optical filter that is desired to be included in a remote terminal in the present application is an optical filter useful for full-duplexing of an access when the remote terminal accesses the space-division multiplexing network via a base station as disclosed in the present application (of course, an effect of removing background light may be included as a secondary effect).

In the present invention, a main remote terminal is contemplated to be a small remote terminal with a less functionality and low cost. This remote terminal should perform half-duplexing intrinsically and should be capable of being carried by a user. For example, an existing IrDA terminal, is assumed in the present specification. Further, since the transceiver in a remote terminal of the sort just discussed is extremely small, there often is a problem in that diffraction of the transmitted light of itself to a receiver is generated and the time for recovery of saturation of the receiving circuit cannot be reduced. On the other hand, in Ota all of Figs. 10, 14 and 22 show a light shielding pipe 108 or a partition board 104 provided between transmitting and receiving elements that form a pair. It can be easily understood from this showing that only full-duplex communication is assumed. Further, to provide the plurality of transmitters/receivers disclosed in Ota (or Welch) or a complicated processing capacity to the remote terminal assumed in the present application completely deviates from the objective of the present application.

Even a remote terminal such as the one described above which has been widely used as a low cost communication link, can be full-duplexed and incorporated into the space-division multiplexing system of the present invention without adding any substantial modification to the existing communication protocol by including the filter of Claim 33. Thus, it is possible to make full use of the effect of multiple connections by space-division multiplexing of the present application.

When remote terminals individually communicate with each other, even the remote terminal assumed in the present application may be limited to half-duplex communication that is intrinsically carried out. Conversely, however, it also can be said that an essential requirement of the present invention is to enable communication among similar remote terminals which are not manufactured for participation into the space-division multiplex system of the present invention. Accordingly, as described in Claim 33, by providing means for attaching and detaching the filter, the above-described objective can be achieved.

Also, even though it has been known since before Knapp that an optical filter can attenuate light of a specific wavelength by its design, and prior to Sumi it was known that not only a camera lens but also a filter portion could be made mechanically movable, Applicant nevertheless respectfully submits that Claim 33 is patentable over the prior art as a portable terminal including an existing communication interface which performs a simple LOS communication that also can be incorporated into the space-division multiplexing system of the present invention without a significant modification to the protocol or increase in a processing load.

With respect to Claims 34 and 35, the Examiner asserts that the system disclosed by Ota includes a transmitter having a plurality of light sources and a signal intensity multiplexer that is used for selecting or detecting a signal having a sufficient intensity from spectrum components.

To the extent that the Examiner's argument relates to the difference between the diversity by space-division and space-division multiplexing it has been discussed in detail above. However, it should be noted that the features of the base station recited in Claims 34 and 35 of the present application relate to duplexing that is totally different from what has been discussed above. Specifically, for the purpose of full-duplexing and incorporating an existing remote terminal at low cost and a low level of complexity into a space division multiplexing system, desirable requirements for the base station transmitter of the present application are disclosed in Claims 34 and 35 of the present application in order to obtain the feature of the remote terminal of claim 33 of the present application to cut a wavelength band used by each of the remote terminals, i.e., the feature that the receiver of the remote terminal cuts a wavelength band of a transmission light thereof.

The system of Ota is only provided for full-duplex communication. Further, the feature of the present invention that relates to switching between full-duplex or half-duplex methods also is not described in Ota. Only the spatial diversity by selecting a channel having a strong signal intensity is described in the Ota reference. Therefore, Applicant respectfully submits that no relationship can be found between Claims 34 and 35 of the present invention and the Examiner's last stated characterization of the Ota reference.

On the other hand, corresponding to Figs. 3, 4 and 5 of the present application, the wavelength band used by a base station transmitter and a wavelength band used by a terminal (wavelength band used by a terminal transmitter and a wavelength band cut by the filter of Claim 33) may be in various combinations depending on which LEDs or LDs are mounted on the respective transmitters of the base station and the remote terminals. Accordingly, the features of the base station of Claim 34 indicate that a wavelength band of any of the light sources of the multi-beam transmitter of the base station transmitter should include a spectrum component having a sufficient intensity different from those of the wavelength bands of the respective terminals disclosed in Claim 33. Thus, even when the remote terminal includes a filter for full-duplexing, a downlink from a base station to a remote terminal becomes always receivable and the full-duplex operation at the remote terminal is made possible. The case in which an LD is used for a base station as described with respect to Fig. 3, for example, may be a preferable example.

The features of the base station of Claim 35 also indicate that a wavelength band of any of the light sources of the multi-beam transmitter of the base station transmitter may include any of the wavelength bands of the respective terminals disclosed in Claim 33 as long as it includes other spectrum components at a sufficient intensity. Thus, even when the remote terminal includes a filter for full-duplexing, a downlink from a base station to a remote terminal becomes always receivable and the full-duplex operation at the remote terminal is made possible. For example, the case in which various LEDs are used in the base stations with respect to Fig. 4 may be a preferable example.

In either of the latter two cases, in the space-division multiplexing system of the present application, multiplexing of the channels is performed by space-division. For the reasons discussed above, Applicant respectfully submits that Claims 34 and 35 are patentable based on the point that the feature of the base station for enabling a portable terminal, which comprises an existing communication interface for performing simple LOS communication, to be incorporated into the space-division multiplexing system of the present application without a significant protocol modification and an increase in processing load is disclosed.

In summary, therefore, Applicant respectfully submits that none of the cited references teach, disclose or suggest an angle diversity receiver that includes a plurality of receiving elements, wherein at least one of the receiving elements is separately associated with each respective one of a plurality of space cells as now explicitly proposed to be claimed. Further, Applicant respectfully submits that this limitation was inherent in the claims of this application prior to the present proposal for its explicit addition. Hence, the presently proposed amendment does not require further consideration and/or search by the Examiner. Furthermore, Applicant respectfully submits that once the Examiner reconsiders this application in view of Applicant's above Remarks tying in the currently proposed Amendment to its previous argument, the patentability of the presently proposed claims over the currently cited and applied art will become abundantly clear.

For each and all of the foregoing reasons and in light of the foregoing Amendment, Applicant respectfully submits that the distinctions between space-division multiplexing on the one hand and space division with time domain multiplexing on the other hand, along with the ramifications of each as discussed above, clearly and convincingly indicate that the Examiner's currently outstanding rejections should be withdrawn. Further, Applicant respectfully submits that the entry of the foregoing proposed Amendment will not introduce any so-called new matter into this application, nor will it require the Examiner to perform unwarranted further consideration and/or searches concerning the subject matter claimed in view of the detailed nature of his previous consideration of the issues herein. In addition, Applicant respectfully submits that the claims as they will stand upon the Examiner's grant of entry to the foregoing Amendment, Claims 26-35 and 37-43, will place this application in condition for allowance, or at least in better form for Appeal as required by 37 CFR 1.116. A decision so holding in response to this communication is respectfully requested.

Applicant also believes that additional fees beyond those submitted herewith are not required in connection with the consideration of this response to the currently outstanding Official Action. However, if for any reason a fee is required, a fee paid is inadequate or credit is owed for any excess fee paid, you are hereby authorized and requested to charge and/or credit Deposit Account No. 04-1105, as necessary, for the correct payment of all fees which may be due in connection with the filing and consideration of this communication.

Respectfully submitted,

Date: March 4, 2005

David A. Tucker

SIGNATURE OF PRACTITIONER

Reg. No.: 27,840

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